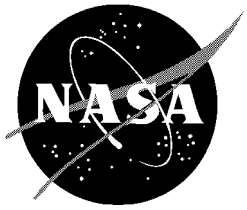

## Mission Assurance in the New Business Environment

# Advanced Quality Systems

## Mission Assurance Up-Front & Built-In

**Vol. 1.3**

*NASA Office of Safety & Mission Assurance*

### What are Advanced Quality Systems (AQS)?

AQS represent the use of systems engineering, quality engineering, business and management practices in a coordinated and integrated way. The Japanese pioneered this concept in the 1950's as "Lean" business principles & practices. The individual pieces have been around forever, … their integrated use is the novelty, and key to success.

**Advanced Quality Objectives Include:** Improved safety and mission success, reduced production cost, increased efficiency, decreased cycle-time, less waste, less rework, and fewer engineering changes.

## Key Concepts of Advanced Quality

***Integrated Product & Process Development Team Approach***
Use of IPPTs is considered an essential component of an Advanced Quality System (AQS).

***Key Characteristics***
Identification of key product and process design features, which must be controlled.

***Robust Product Design***
Reduction in number of key characteristics and failure modes.

***Metrics, Measurement & Analysis***
Extensive use of ***statistical process control*** is considered essential to characterize ***process stability (Cp)*** and ***capability (Cpk)***. Appropriate Quality metrics and Quality participation in the ***incentive fee*** determination.

***Robust Process Design***
Continual process improvement including use of ***Design of Experiments*** and variation control techniques, such as ***process fail-safing (Poke-Yoke)***.

***Costs of Quality***
Identification of ***Quality Prevention, Appraisal, and Failure*** costs will assist in better business decisions.

***Supplier Flowdown***
Supplier implementation of AQS.

## AQS In Design & Development

- Identify Key Product Characteristics (KPC)
- Minimize Key Product Characteristics
- Identify KPC critical tolerances
- Conduct design for assembly/design for manufacturing analyses
- Conduct product Failure Modes and Effects Criticality Analysis (FMECA)
- Develop critical failure mode mitigation strategies
- Conduct geometric dimensioning and tolerance analyses

## Design & Development AQS Metrics

- Percentage of drawings for which key characteristics have been identified
- Percentage of key characteristics for which control methods have been identified
- Average number of key characteristics per drawing
- Part complexity indices
- Percentage of critical failure modes among all failure modes (product and process FMECA)
- Percentage of drawings for which Geometric Dimensioning and Tolerancing (GD&T) has been employed

## AQS in Manufacturing

- Identify critical (key) processes
- Identify key control characteristics
- Conduct process stability & capability analyses
- Conduct process FMECA
- Establish process baseline metrics
- Conduct reproducibility studies
- Conduct repeatability studies

- Conduct gauge and metrology calibration and repeatability studies
- Formally validate tooling and processes
- Establish process monitoring and feedback systems as appropriate
- Implement process fail-safing (adaptive machine control or Poka-Yoke)
- Implement closed-loop, root-cause corrective action
- Implement supplier AQS programs and establish electronic data sharing arrangements

## Manufacturing AQS Metrics (continued)

- Process capability indices Cp and Cpk
- Percentage of key processes with Cpk values at 1.33 or higher
- Percentage of key processes with process fail-safing controls implemented
- Failure (e.g., scrap, rework, and repair) costs as a percentage of total quality costs (prevention + appraisal + failure) or as a percentage of sales or direct labor costs
- Number of nonconformances
- Number of open nonconformances
- Average disposition time per nonconformance
- Percentage of suppliers who are ISO 9000 and/or advanced quality certification
- Percentage of nonconformances attributable to suppliers

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